3GPP TSG RAN Meeting #71 **RP-160680**
Gothenburg, Sweden, 7 - 10 March 2016

Source:	**MediaTek Inc., CMCC**
Title:	**New work item proposal: Downlink Multiuser Superposition Transmission for LTE**
Document for:	**Approval**
Agenda Item:	**10.1.1**

3GPP™ Work Item Description

For guidance, see 3GPP Working Procedures, article 39; and 3GPP TR 21.900.
Comprehensive instructions can be found at http://www.3gpp.org/Work-Items

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Title: Downlink Multiuser Superposition Transmission for LTE

Acronym: LTE_MUST

Unique identifier:

NOTE: If this is a RAN WID including Core and Perf. part, then Title, Acronym and Unique identifier refer to the feature WI. Please tick (X) the applicable box(es) in the table below:

This WID includes a Core part	x
This WID includes a Performance part	x

1 3GPP Work Area

x	**Radio Access**
	Core Network
	Services

2 Classification of WI and linked work items

2.0 Primary classification

This work item is a …

	Study Item (go to 2.1)
x	**Feature (go to 2.2)**
	Building Block (go to 2.3)
	Work Task (go to 2.4)

NOTE: Core, Performance and Testing parts of RAN WIs are usually Building Blocks.
If you are in doubt, please contact MCC.

2.1 Study Item

Related Work Item(s) (if any]		
Unique ID	**Title**	**Nature of relationship**

Go to §3.

2.2 Feature

Related Study Item or Feature (if any)		
Unique ID	**Title**	**Nature of relationship**
	Downlink Mutiuser Superposition Transmission for LTE	

Go to §3.

2.3 Building Block

Parent Feature (or Study Item)		
Unique ID	**Title**	**TS**

This work item is …

	Stage 1 (go to 2.3.1)
	Stage 2 (go to 2.3.2)
	Stage 3 (go to 2.3.3)
	Test spec (go to 2.3.4)
	Other (go to 2.3.5)

2.3.1 Stage 1

Source of external requirements (if any)		
Organization	**Document**	**Remarks**

Go to §3.

2.3.2 Stage 2

Corresponding stage 1 work item		
Unique ID	**Title**	**TS**

Other source of stage 1 information		
TS or CR(s)	**Clause**	**Remarks**

If no identified source of stage 1 information, justify:

Go to §3.

2.3.3 Stage 3

Corresponding stage 2 work item (if any)		
Unique ID	**Title**	**TS**

Else, corresponding stage 1 work item		
Unique ID	**Title**	**TS**

Other justification		
TS or CR(s) or external document	**Clause**	**Remarks**

If no identified source of stage 2 information, justify:

Go to §3.

2.3.4 Test spec

Related Work Item(s)		
Unique ID	**Title**	**TS**

Go to §3.

2.3.5 Other

Related Work Item(s)			
Unique ID	**Title**	**Nature of relationship**	**TS / TR**

Go to §3.

2.4 Work task

Parent Building Block		
Unique ID	**Title**	**TS**

3 Justification

The study item of Downlink Multiuser Superposition Transmission (MUST) was approved with the objectives including identifying possible enhancements of downlink multiuser transmission schemes within one cell, evaluating potential system level gain and performance/complexity trade off under realistic deployment scenarios and traffic model, and identifying required standard changes needed to assist UE to cancel or suppress intra-cell interference. RAN1 identified three MUST categories and candidate receiver schemes for MUST near and far users. RAN1 also identified potential parameters of assistance information for each identified receiver type to support MUST operation. These parameters may be signalled through higher-layer signalling or physical-layer control channel, blindly detected by receivers, tied to UE's scheduling information or tied to specific UE assumptions. CSI enhancement is also identified as a potential way to increase the probability of MUST user pairing.

Based on the study for MUST, the following conclusion is drawn for PDSCH in TR 36.859:

- MUST can increase system capacity as well as improve user experience in certain scenarios at least for 2Tx case

  - MUST is generally more beneficial when the network experiences higher traffic load
  - MUST is generally more beneficial in user perceived throughput for wideband scheduling case, compared to subband scheduling case
  - MUST is generally more beneficial in user perceived throughput for cell-edge UEs, compared to other UEs
- MUST-far UEs can be legacy UEs when QPSK is applied to MUST-far UEs or the most two significant bits in the modulation symbol are assigned to far UE

In order to realize the observed performance gain of MUST in commercial deployments, it is proposed to start the work item phase to specify necessary mechanisms, including MUST transmission schemes and signalling, to enable MUST operation. After the core specification works are completed, the corresponding performance requirements can be specified in RAN4.

4 Objective

4.1 Objective of SI or Core part WI or Testing part WI

The work item is to specify necessary mechanisms to enable LTE to support downlink intra-cell multiuser superposition transmission for PDSCH with assistance information from serving eNB to a UE regarding its experienced intra-cell interference. A MUST UE receiver is assumed to be capable to cancel or suppress intra-cell interference between co-scheduled MUST users for the following cases.

Case 1: Superposed PDSCHs are transmitted using the same transmission scheme and the same spatial precoding vector

Case 2: Superposed PDSCHs are transmitted using the same transmit diversity scheme.

Case 3: Superposed PDSCHs are transmitted using the same transmission scheme, but their spatial precoding vectors are different.

The detailed objectives include:

1. (RAN4) For Case 1, 2 and 3, identify and agree on the parameter combinations that could be blindly detected jointly for MUST based on TR36.859 and RAN1's recommendation.

2. (RAN1) For Case 1 and 2 using up to 2 Tx CRS-based transmission schemes, specify downlink multiuser superposition transmission scheme(s) for MUST category 2 with multiple transmission power ratios or MUST category 2 with single transmission power ratio & legacy constellation for co-scheduled MUST users in each constellation combination.
   - Down-selection should be further discussed in RAN1.

3. (RAN1) For Case 1 and 2 using up to 2 Tx CRS-based transmission schemes, specify necessary mechanisms to enable efficient MUST operation.
   - The configuration of downlink multiuser superposition transmission.
   - Starting from the candidate parameters of assistance information identified in TR 36.859 and based on the RAN4 identified parameter combinations which could be jointly blindly detected, specify the mechanism to provide MUST assistance information to a UE using R-ML receiver, which may include assistance signalling and blind detection.

4. (RAN1) For all three Cases using up to 4 Tx CRS-based or up to 8 Tx DMRS-based transmission schemes, evaluate the system-level performance based on the evaluation methodology and assumptions in TR36.859.

5. (RAN1) For all three Cases using up to 4 Tx CRS-based or up to 8 Tx DMRS-based transmission schemes, identify and, if needed, specify necessary enhancements for MUST operation, following the outcomes of objective 1 to 4.

6. (RAN2) Specify necessary higher-layer signalling to support the objectives listed above.

Note: CSI enhancement is not part of this WI.

4.2 Objective of Performance part WI

NOTE: Leave empty if the WI proposal does not contain a RAN performance part.

1. Specify UE demodulation requirements based on the mechanisms specified in the core part of the work item.
2. Ensure negligible performance loss compared to MUST with perfect assistance information for a UE in all intra-cell PDSCH interference scenarios for Case 1, Case 2 and Case 3 listed in Section 4.1, including per PRB or PRB-pair based resource allocation for interfering PDSCH, and/or lack of assistance signalling, in a wide range of typical network deployment conditions.

4.3 RAN time budget proposal

NOTE: For WIs/SIs under RAN WG5 leadership this section is not filled out. Otherwise: For a not yet approved WI/SI the rapporteur has to fill out the last row of the table(s) below up to the target date of the WI/SI (if necessary add further tables): Indicate the number of time units (1 TU ~ 2h), i.e. one value for each session/field. If no time unit is needed, leave the field empty.
Once the WI/SI is approved, the tables below will no longer be updated in the WI/SI description (i.e. the tables reflect the status of the initial approval). But changes can be proposed in the status report of the WI/SI.

RAN #71									**Q2/2016**									**RAN**	
#72																			
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf	R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
84bis	84bis	93bis	93bis	93bis	91bis	78bis	78bis	78bis	78bis	85	85	94	94	94	92	79	79	79	79
1										**1**							**0.5**		

RAN #72					**Q3/2016**				**RAN**
#73									
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
86	86	95	95	95	93	80	80	80	80
1.5							**1**		

RAN #73									**Q4/2016**									**RAN**	
#74																			
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf	R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
86bis	86bis	95bis	95bis	95bis	93bis	80bis	80bis	80bis	80bis	87	87	96	96	96	94	81	81	81	81
2							**0.25**			**2**		**0.5**					**0.25**		

RAN #74					**Q1/2017**				**RAN**
#75									
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf

88	88	97	97	97	95	82	82	82	82
									1

RAN #75 #76									**Q2/2017**									**RAN**	
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf	R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
88bis	88bis	97bis	97bis	97bis	95bis	82bis	82bis	82bis	82bis	89	89	98	98	98	96	83	83	83	83
									1										**1**

RAN #76 #77					**Q3/2017**			**RAN**	
R1L	R1U	R2L	R2U	R2J	R3	R4RF Core	R4RD Core	R4RF Perf	R4RD Perf
90	90	99	99	99	97	84	84	84	84
									1

L: LTE, U: UMTS, J: Joint, RD: RRM/demodulation

NOTE: In case further explanation of the time budget proposal is needed, then please explain this below.

additional comments to the time budget proposal:

5 Service Aspects

6 MMI-Aspects

7 Charging Aspects

8 Security Aspects

9 Impacts

Affects:	**UICC apps**	**ME**	**AN**	**CN**	**Others**
Yes		**x**	**x**		
No	**x**			**x**	**x**
Don't know					

10 Expected Output and Time scale

New specifications [If Study Item, one TR is anticipated]						
Spec No.	Title	1st rsp. WG	2nd rsp. WG(s)	Presented for information at plenary#	Approved at plenary #	Comments

NOTE: If this is a RAN WID including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Comments for each spec.
By default a new specs can only be new for one of both parts.

Affected existing specifications [None in the case of Study Items]				
Spec No.	CR	Subject of the CR	Approved at plenary#	Comments
36.211		Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation	RAN #74	Core part
36.212		Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding	RAN #74	Core part
36.213		Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures	RAN #74	Core part
36.331		Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification	RAN #74	Core part
36.101		Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception	RAN #77	Perf. part

NOTE: If this is a RAN WID including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Comments for each spec.
If an existing spec is affected by both (Core part and Perf. part), then it has to be listed twice with appropriate approval dates.

11 Work item rapporteur(s)

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12 Work item leadership

Primary: RAN1 WG
Secondary: RAN4 WG, RAN2 WG

NOTE: If this is a RAN WID including Core and Perf. part, then this WG specifies the WG leading the Core part.
RAN WG4 is by default leading the Perf. part.

13 Supporting Individual Members

Supporting IM name
MediaTek Inc.
Acer
Broadcom
CATR
CATT
CMCC
China Telecom
China Unicom
CHTTL
Coolpad
Fujitsu
HiSilicon
Hitachi
HTC
Huawei
III
ITL
ITRI
KDDI
Kyocera
Mitsubishi Electric
NEC
Nokia Networks
NTT
NTT Docomo
Oppo
Orange
Potevio
Samsung
Sequans
Sharp
Sierra Wireless
Softbank
Sony
Spreadtrum
Sumitomo Electric
TCL
ZTE